The Excavating Engineer

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Strip Mining with Electricity at Colstrip, Montana

Foley Brothers' Operation of an All-Electric Pit for the Northern Pacific Railway. This Work, Carried on Under Unusual Contract, Is Saving the Railroad About $700,000 per Year

DURING the past few decades we have seen one industry after another become electrified. Within the last few years we have seen a decided increase in the use of electrically-driven excavating machinery, in fact, a phenomenal increase in the use of this electric machinery for coal mining. To him who is unaccustomed to the use of such machinery, this seems unusual, but when the difficulty of obtaining good boiler water is considered, it is not surprising that electrically-driven excavating machinery, with its clean and silent operation, its low upkeep and lack of fuel consumption when standing by, should displace the older steam machine.

On the work with which this article deals, we find the well-known contractors, Foley Brothers, Inc., operating complete electrical equipment on a coal deposit where bringing in the electric power necessitated the building of 100 miles of transmission line.

These operations of Foley Brothers, Inc., for the Northern Pacific Railway Company are for the recovery of the semi-bituminous coal of the Rosebud Vein, which underlies about 700 square miles in Montana and a much larger but unmeasured area in Wyoming. From an outcrop survey of this region, it was estimated that this vein in Montana included about six billion tons.

Two Hundred and Forty Million Tons Shown by Exploration

The Northwestern Improvement Company, a subsidiary of the Northern Pacific Railway, operates mines at Red Lodge, Montana. But because of the possibility of developing a more economical supply of locomotive fuel, the Chief Engineer of the Railway was directed in 1917 to make a thorough investigation of the Rosebud field. The outcrop survey showed that the Rosebud vein was closely underlain through practically the entire area by the McKay vein; the parting between the two veins of coal varied from 3 feet to 20 feet, and it is, therefore, assumed that the two measures are really part of the same deposit. In February, 1919, the Chief Engineer had completed his survey, and submitted a report of the exploration of 15 square miles in the northern part of the coal field near the head waters of the Armell Creek. A complete topographic survey of this tract was made, and a large number of borings were put down so that the top and bottom of the seams were determined. This made it possible to construct what in reality was a topographic map of the ground surface, the top of the coal and

A general view of the pit showing overburden stacks and depth of coal seam. This picture was taken at the time of an inspection trip by the Northern Pacific officials and their guests.

the bottom of the coal. This survey showed that 150 million tons lay above the 100-foot level and was accordingly classed as stripping tonnage, and that about 90 million tons, assuming that 50% could be recovered, lay below this level and is classed as mining tonnage.

Samples Show Poorer Quality but High Possible Annual Savings

To obtain accurate information as to the value of the coal, some 400 tons was mined by shaft method. Locomotive tests with this specially mined quantity made comparisons with Red Lodge coal possible. These tests comprised six round trips with heavy freight locomotives over an undulating 1% grade. These tests showed that it was advisable to make comparison between the two coals upon the basis of one ton of Red Lodge coal to 1.4 tons of Rosebud. The actual figures were as follows:

	Red Lodge	Rosebud
Pounds of water evaporated per pound of coal	5.81	4.33
Pounds coal per 1,000-ton miles	104	146
Pounds coal per drawbar h. p. per hour	4.79	6.77
Tonnage hauled	1,794	1,783

Tests of the samples of coal which were taken out of shafts and of drill holes gave approximate analysis as follows:

Loss from air drying	12.30
Retained moisture	11.08
Volatile combustible	51.20
Fixed carbon	29.94
Ash	7.77
Sulphur	0.67
B. T. U.	10,825

The results of these investigations made it apparent that even assuming no additional traffic on the Northern Pacific's line between Mandan, North Dakota, and Missoula, Montana, the use of the Rosebud coal instead of the Red Lodge coal for their locomotives would bring about a saving of at least $700,000 a year.

Although the report upon the field was made in February, 1919, the project was not authorized until 1922, and early in 1923 a branch line was built by Winston Brothers of Minneapolis. This branch line from the main line of the Northern Pacific to Colstrip, was completed in December, 1923; ballasting was done in 1924, and the line was put in operation in September of that year.

During the construction of the branch line a small pit was opened in that part of the field where the overburden was comparatively shallow, and 45,000 tons of coal was taken out of the vein and used for the determination of the proper method of firing. In mining this test quantity the overburden was stripped by grading machines.

Foley Brothers Obtained Contract

Although the Northwestern Improvement Company, a subsidiary of the Northern Pacific Railway Company, was operating the mines at Red Lodge, Montana, it was not equipped to handle such a large open cut mining proposition as the work planned at Colstrip. The Northern Pacific Company, therefore, decided to start operations by a contract designed to have their own company continue the work after the contract period of five years. The contract was arranged so that the contractor would select and install all equipment and plant (except rails and ties, which will be supplied by the railroad company)

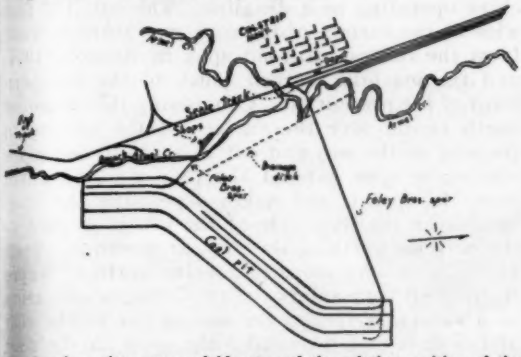
The loading spur is run on the east side of the stripping surface of the coal. The 7-yard electric loading shovel is here loading a train of 55-ton cars standing on top of the 28-foot face of coal.

and arrange to turn the entire plant over to the company at the end of the five-year period. All bids were made upon the basis of the prospect borings which were made by the Northwestern Improvement Company. The contract calls for ten semi-annual payments to the contractor for equipment including camp and all parts of the coal field plant. The contractors bid at a unit price per cubic yard and the Northwestern Improvement Company agreed to assume all risk of variation of rates of pay during the life of the contract.

In comparing bids all figures were reduced so that the bids might be compared on a basis of cost to the railroad company per cubic yard of coal. It was rather unusual that of two bidding firms, Foley Brothers, Inc., and Winston Brothers, the difference was only $6,150 on an estimated volume of 6,300,000 cubic yards of stripping. Foley Brothers, however, was awarded the contract, as their figure for loading the coal was substantially below that named by Winston Brothers.

Considerations Which Led to Electrical Equipment

Because the test shafts which were put down to obtain coal for the preliminary locomotive tests had filled with water, it was expected that drainage of the stripping operations when finally gotten under way would provide the necessary water for boiler purposes.



Showing how the cuts are laid out, and the relative position of the pit to Colstrip, railroad sidings, etc.

When, however, the test pits of 1924 were opened, it developed that there was no dependable supply of water either above or below the coal seam, and this quite definitely determined that electric operation was the only reliable method of mining the coal, in spite of the fact that the use of electric power made necessary a 100-mile power line from Billings, Montana. The choice of locomotive power, however, presented still more serious problems, for while the use of steam locomotives meant that boiler water would have to be hauled from the main line of the Northern Pacific, electric locomotives did not fit into the layout, as the work was planned so that the stripping shovel would, after the first cut, have to swing over the loading track to dump the spoil into the old cut, constantly courting trouble by contact of shovel with trolley. A third rail installation was not looked upon favorably because of the danger to the men. These considerations brought about the use of storage battery locomotives, which had the great advantage of using neither a trolley nor a third rail.

Operations Started in the Summer of 1924

In the summer of 1924 the contractors started operation on the open cut with a Marion 360 dragline with a 150-foot boom and 6-yard Page bucket, stripping a box cut. On the second stripping cut this machine was converted to a shovel, with a 90-foot boom, 66-foot dipper sticks and 6-cubic-yard dipper. A few months later an 8-yard dipper was substituted.

The coal is being loaded with a Bucyrus 175-B Electric Ward-Leonard direct current generator field control shovel, equipped with a 7-yard coal dipper. Incidentally this shovel is novel in that it has shunt motors on each of the three motions. (The motors are General Electric.) Hauling is done with General Electric 70-ton standard gauge storage battery locomotives. A Northwest dragline is used for cleaning coal. The stripping is drilled with a Sanderson-Cyclone drill, electrically equipped. An American Hoist & Derrick 20-ton locomotive crane has been provided for general use on the field. There is one portable Ingersoll-Rand electric compressor and one portable Chicago-Pneumatic compressor, gasoline driven. All equipment was provided with a complete set of spare parts, and a machine shop was provided completely equipped with new tools, which were all operated by direct connected motors and were well adapted for any machine work which might come up during the operation of the coal field.

8,000-Foot Pit Opened

One of the spur tracks built to the coal pit by Foley Brothers crosses a branch of Armell Creek and enters the pit a little to the south of the center of the workings. Here the stripping machine was cut in and worked south, piling the overburden to the west of the cut. The loading spur was run in on the east side of the stripping

Digging into the face for seven yards of coal. Note how coal is broken down from face.

on the surface of the coal. Following the stripping shovel south the 7-yard electric coal-loading shovel loaded trains of 55-ton cars standing on the rail on top of the 28-foot face of coal.

Storage Battery Locomotive Charges During Loading Period

Although the transmission line from Billings, Montana, to Colstrip transmits electric energy at 55,000 volts, the power is delivered to both the stripping and coal-loading shovels at 2200 volts. On the base of the coal-loading machine is arranged a bank of transformers solely for the purpose of supplying energy to the electric locomotives. These transformers cut down the current from 2,200 volts to 440 volts, and a cable carries this low voltage to a cable reel car stationed on the loading track. The locomotive when it brings

The 7-yard dipper emptying its load into a car. The size of the dipper can be well estimated here by comparison with the men standing at the left.

in a train of empty coal cars hooks on to the cable car and charges its batteries during loading period, a motor generator set for converting the alternating current to direct current being located in the cab of the locomotive.

A 55-Ton Car Every Six Minutes

The shovel working against the face of blasted coal loads out a 55-ton car every six minutes, and thus fills a 10-car train in approximately one hour. This gives time for the locomotive to charge its batteries with more than enough energy to make the trip from the pit out to the main line.

Both Powder and Dynamite Used in Blasting

In blasting the overburden, holes are chambered with du Pont ammonia dynamite 60% strength, and the explosive used for breaking up the material is railroad grain blasting powder. Holes are primed with electric blasting caps embedded in a cartridge of 40% ammonia dynamite.

The face of the coal is semi-circular to conform to the cutting radius of the shovel. The face, which is 25 feet high, is shaken up by the use of explosives.

Planning of the Cuts

The new pit running roughly in a north and south direction was opened by the stripping machine operating as a dragline. The cut, 112 feet wide at the surface of the coal, was started south from the central railroad spur in August, 1924, and the machine worked south to the southern limit of the present pit. Completing this it moved north again, over the surface of the ground to the east of the cut, and cut in again at the place where the spur entered the pit; working north from this point, and again depositing the overburden on the west side of the pit, it worked to the extreme north of the present workings. Then idling back once more to a point north of where the central spur enters the pit, it began operation as a shovel, stripping the second cut to the east of the first and depositing the spoil in the first cut, from which the coal had just been loaded. In this manner the two machines came together at the north end of the cut, and then the stripping machine idled back and worked south from the first point, the loading shovel following.

After the stripping shovel reached the south end of the pit it was idled back on top of the coal and passed the loading shovel about midway between the two ends of the field. It then proceeded to strip from that point to the north end of the field, depositing the stripped material where the coal had been loaded from cutting No. 2. Upon reaching the north end of the field the stripping shovel idled back to the point where it had just previously passed the loading shovel, and began stripping south, following the loading shovel. In this manner the machines will be in position to meet and pass at the south end of the pit in the late spring of this year.

At this point there will be one entire stripping cut ahead of the loading shovel, and the machines thereafter will maintain their relative positions. In addition to the first entrance track, which was brought in at a point midway between the center of the field and the south end, a second entrance track has been brought in and connected to the loading track at the north end of the field. The stripping shovel swings across the loading track to dump.

Mr. H. E. Stevens, chief engineer of the Northern Pacific Railway, St. Paul, Minnesota, supervised the engineering work for the opening and the development of the field. The operation of the field is under the general supervision of Mr. C. C. Andersen, general manager of the Northwestern Improvement Co., Seattle, Washington. From the fall of 1924 until the spring of 1926

Mr. Lochren Donnelly, now deceased, was superintendent for the Northwestern Improvement Co. in direct charge of the field operations, with headquarters at Colstrip. At the present time Mr. Swem, chief engineer of the Northwestern Improvement Company, is in direct charge of field operations.

For Foley Brothers, the operation has been under the general direction of E. T. Foley and D. A. Daly. R. J. Gjerde is field superintendent.

One of the electrically-hauled trains at the loading shovel. The storage battery locomotive has hooked on to the cable reel car in the foreground, charging its batteries during the loading period.

A Lottery

We were looking over the May issue of Business just the other day, and the following story is included in the columns of that magazine. Incidentally, we would like to say, as did the editor of that magazine, that the story is a new one to us.

Over in New Jersey somewhere lived a farmer who owned a saddle horse; and the saddle horse was for sale. In New York lived a horseman who lacked a horse.

Hearing of the horse in New Jersey, the New Yorker journeyed over there to look at the animal.

"How much?"

"Five hundred," said the Jerseyite.

"Too much," said the New Yorker. "Make it four."

"Five," said the Jerseyite, "or no sale."

"Suit yourself," concluded the New Yorker. And he went home horseless.

That night the horse suddenly fell ill — and died.

"Shucks!" said the Jerseyite. "Wish I'd taken that fellow's offer! But — let's see — why not take it anyway. Good idea!"

Into a freight car went the dead horse, consigned to the man in New York. Then an interchange of telegrams; and the New Jerseyite had his four hundred.

A week passed — ten days — two weeks. Apprehensively, the New Jerseyite waited for some word from New York. None came. What had happened?

Overcome with curiosity, the New Jerseyite journeyed to New York and found the man to whom he had shipped the horse. And the dialogue between them went as follows:

"Well, how's everything with you?"

"Fine! And how's everything over on the farm in Jersey?"

"Oh, pretty fair. But say, about that horse I sold you — was it satisfactory?"

"The horse? Oh, it was dead. Yeh, dead when it got here."

"Dead? That's strange! But what did you do with it?"

"Raffled it off. Yeh, I sold a hundred tickets for ten dollars each — course, the fellows that bought 'em didn't know the horse was dead — and raffled it off."

"But listen! Somebody had to win it. How did you fix it with him?"

"The winner? Oh, I gave him back his ten dollars."

Some Potatoes

An eastern farmer, who had moved to California, heard that his neighbor had raised some very large potatoes, so he sent his hired man over to get a hundred pounds.

"Go right back," said the Californian, "and tell your boss that I won't cut a potato for any man."

General View of the David Mitchell Estate Quarry at Cave Hill, Victoria.

Australian Limestone Quarry and Lime Plant

An Outline of the Operations of a Quarry, Owned and Operated by the David Mitchell Estate, at Cave Hill, Victoria, About 27 Miles from Melbourne

AT Lillydale, Victoria, about 27 miles from Melbourne, the Cave Hill Limestone Quarry has been in operation for many years. A story of the operation may prove of interest to our readers. It will at least permit our American readers to make an interesting comparison between the methods used in Australia and the methods used at home.

It should be of particular interest to note that the new equipment of the plant includes a Bucyrus 30-B shovel equipped with a 1-yard dipper and a Whitcomb 7-ton gasoline locomotive.

The 1-yard Diesel-Engine-Driven Shovel Loading Overburden into Horse-Drawn Dump Cars

The Commonwealth Engineer, in an article upon the quarry, refers to the production methods as unusual, and the plant as a "novel" one in its design and operation.

Diesel Shovel Used for Stripping

The overburden is removed with the Bucyrus 30-B Diesel-engine-driven shovel, which is mounted on caterpillars and equipped with a 1-yard dipper. This shovel loads side dumping cars which are spotted on tracks on either side of the machine. They are hauled away from the machine by an electric mule. They were formerly handled by horses.

The operation of the plant is well outlined by the flow sheet shown below. From this it will be seen that the operations result in three primary products: sugarstone, used for the treatment of beet sugar; fluxstone, for the metallurgical industries; crushed rock, for road ballasting; and kilnstone, supplied to the kilns and converted to burnt lime. The road stone is supplied in sizes which are specified by the Board of County Roads of Victoria.

At the present time an extension to the lime plant is under construction, and the operation of this will increase the products of the company, enabling them to supply agricultural lime, lump lime and hydrated lime. The layout of the crushing plant is such that all of the material from the quarry is utilized.

Two Kinds of Rock Quarried

The deposit is composed of first-class stratified limestone and a low-calcium, high-silica stratum, which is extremely hard and makes first-class road ballast and concrete aggregate. The strata vary in thickness from 18 inches to 12 feet, and the ratio of limestone to ballast rock is about 3 to 1. The deposit lies at an angle of about 80 degrees to the horizontal. The separating planes are very definite.

Hand Loading Made Necessary by Formation

The operators claim that due to the peculiarities of formation, hand loading is necessary. The rock is, therefore, broken up by small charges placed in holes drilled by jackhamers. The material is thus broken to a size which can conveniently be handled by one man. The limestone, ballast stone and waste, are all taken from the

quarry face in V-body "side-tipping" dump cars of 1-cubic-yard capacity. These are pushed by hand from the face of the quarry to the loading hopper at the foot of the incline leading to the crushers. The skip cars, when they reach the bottom of the incline, enter a pit below the loading hopper. This pit serves the double purpose of making it possible to keep the hand-pushed cars on a perfectly level track and provides a drainage sump for the quarry. The lower section

Note the Arrangement of Two Loading Tracks at the Shovel

of this pit is kept at a definite water level by an automatically operated, electric-motor-driven centrifugal pump.

Over the drainage sump and the pump is built a house of heavy reinforced concrete, which is used by the men as a shelter during blasting.

Two Balanced Skip Cars

The material is brought up to the crushing plant over an incline, on which are operated two balanced skip cars having a capacity of five tons each. The cars are operated by a double drum skip hoist 60 inches in diameter, grooved for a 1-inch cable, and driven, through a worm gear, by a 30 horsepower motor. A solenoid provides electric braking, and a hand brake is available for emergency use.

The Crushing Plant

At the top of the incline the skip cars are dumped into a receiving hopper from which the stone is delivered to the primary crusher by a steel apron feeder 3 feet 6 inches wide. This apron feeder is driven by a variable speed motor which may be mechanically adjusted to feed the material to suit variation in the stone or the capacity of the crusher. By simply reversing the feeder, waste material and the slight amount of overburden encountered on the quarry floor may be sent to the waste bins.

The primary crusher is a hammer mill type driven by an 80 horsepower motor, and operated with breaker plate only. It has hammers specially designed to produce the minimum amount of material too small for use in the limestone kilns. The product, which ranges in size from 6 inches by 8 inches by 2½ inches maximum thickness down to dust, is passed over a shaker screen conveyor with 1¼-inch perforations. The fines are passed into the screening bins, and the remaining limestone to be used in the kilns is delivered into two limestone bins, each having a capacity of 200 tons.

When stone for road ballast is passed into the crushers, the openings over the limestone bins on the shaker screen conveyor are closed, and the product passes into the ballast bin. From this last bin the ballast material is fed by a cradle feeder to a belt conveyor which delivers it to the secondary crushing plant.

This same belt conveyor also delivers the limestone screenings to the secondary crushing plant; a screw conveyor with an adjustable feed grate carrying the material from the screening bin to the belt. The plant is so arranged that the screenings may be run independently if it is desired.

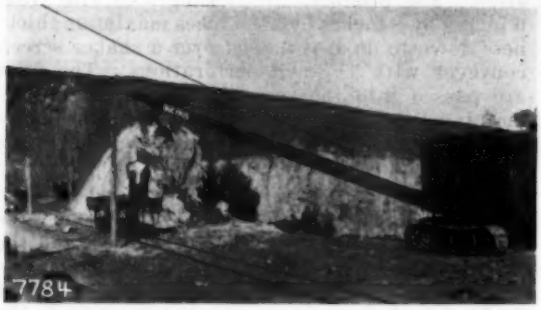
Stone to be used for flux in metallurgical industries is produced by passing stone for the lime kilns off the end of the shaker screen conveyor down the end of a retarding spout, where it is delivered into one of the bins in the secondary crushing plant.

The special stone for use in the sugar beet industry is produced in a similar manner, except that the shaker conveyor is fitted with a bar screen over the limestone bin and all the limestone over four inches passes on as sugarstone.

Diesel-Driven Shovel in Use as Crane with Home-Made Boom

The secondary crushing plant is equipped with jaw crushers into which the material is passed from two adjustable rotating grizzlies.

A 7-ton gasoline-driven Whitcomb locomotive is used for charging the kilns. The installation of this machine is unusual in Australia. To quote an Australian paper: "It has been found after

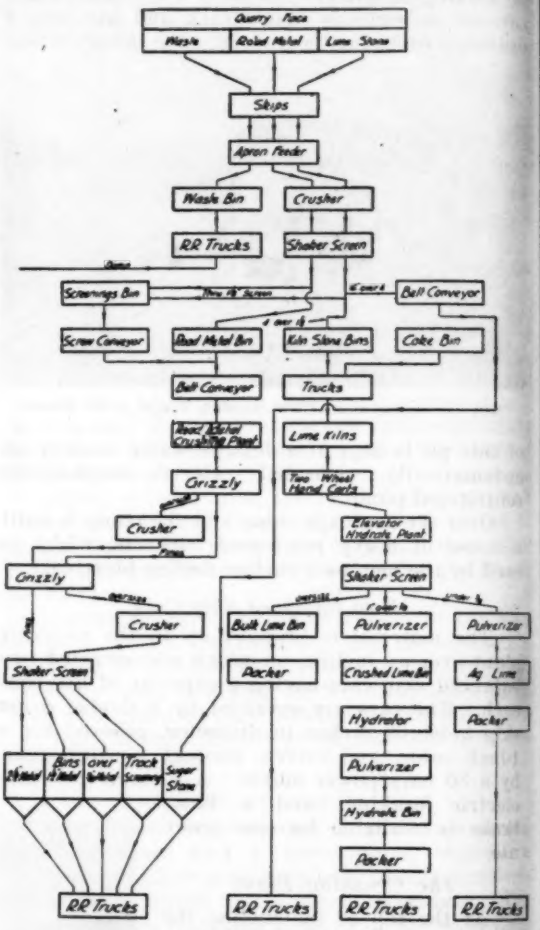


The bucket is so balanced that a sharp tap on the latch release allows it to turn over and dump its load

several months' operation that, even in spite of the short radius curves around the top of the kiln no running troubles have occurred, and, with the side-tipping cars used, this method of charging the kilns has been found to be decidedly economical."

Loading the special bucket. The boom of the crane is seen across the top of the picture, and the bucket, with the men loading it, in the lower right-hand corner.

The charging trains are loaded first with the proper amount of limestone from the bins, and then taken in to the coke heap where the required amount of fuel is placed on the top of each truck load of stone. This method has proved of great value, both from the ease with which the exact lime-fuel ratio may be maintained and



Flow Sheet of Plant

the excellent nature of the product yielded by the kiln.

One interesting feature of the operations occurred during the latter part of 1925 when it became desirable to use the Diesel-driven shovel as a crane. No crane boom was available, as the machine was purchased with only shovel equipment. Since it was desired to carry out the operation requiring the crane at an early date, it was decided to construct the boom on the job.

Quite naturally this home-made boom prob-

ably cost more than if one had been bought from the maker of the machine, but since it was needed in a hurry, making it at home seemed the only solution. The boom consists of two pieces of seasoned Oregon pine 4 inches x 14 inches by 51 feet long, braced laterally with ⅜-inch x 2-inch bars riveted with one rivet in the intersections, placed diagonally on certain sections, and attached with 3-inch x ⅞-inch wood screws to the top and bottom of the boom. At intervals of six feet, long rod bolts were placed to keep the boom from spreading. A piece of pipe around the bolts took care of any compression stresses. Each of these long bolts was provided with four large washers, 1-inch x 4-inch x ¼-inch, two inside and two outside of the main members of the boom.

The fitting at the foot of the boom consisted of two channel irons 3 inches x 12 inches x 5 feet, with angles riveted at the lower end to take the thrust of the two wooden members. The channels were bolted to the wooden members with eight bolts on each side. At the boom point two straps of ¼-inch x 10 inches were fitted over the end of each of the wooden members, extending from the end of these members about three feet toward the foot of the boom. The shaft on the boom point was a 3-inch pin and carried both a hoisting sheave and the boom suspension sheaves. The straps around the ends of the main boom members were drilled and help to carry the thrust on the shaft. Spreaders were fitted at the top and back of the hoisting sheave.

After the crane boom was completed the machine, located on the top of the quarry face, was used with a 2/3-cubic-yard bucket, to bring material from the quarry floor to the surface and deposit it in dump cars.

The buckets were cylindrical, 36 inches deep by 30 inches in diameter, with pins fitted to the side of the bucket acting as pivots for the bail at a point 11 inches from the bottom of the bucket. A special catch was provided and attached to the bail, to lock the bucket in an upright position. To dump the bucket a slight tap upward on the latch released the bucket, which would turn over and very nearly return to the upright position again. The operation of this home-made equipment has been quite successful.

The electric mule and electric motors throughout the plant were manufactured in Australia by Messrs. Chas. Ruwolt Pty. Ltd., Richmond, Victoria. The design of the entire plant, together with the supervision during construction, was carried out by Messrs. Gilbert, McAuliffe Pty. Ltd., consulting engineers, Melbourne.

Grading a Freight Yard for the Wabash Railway

The Carmichael-Cryder Company's Use of Conveyor Equipment to Supply 500,000 Cubic Yards of Material for North Kansas City Yard

EARLY in 1925 the Wabash Railway acquired about 110 acres adjacent to their right-of-way in North Kansas City. This land was obtained to give room for new general yards, serving and providing for freight and engine facilities for the Kansas District. The work to be done in improvement of this tract consisted of several miles of sewers, ranging from eight inches to forty-eight inches, about 500,000 cubic yards of grading, fifteen to twenty miles of yard tracks, an engine terminal, and an extension of the present grain elevator. The original contract called for about 350,000 cubic yards of grading.

Two Plans for Filling Site Were Considered

The invitation to bid for the work provided for two methods of making the fill: *First,* by taking sand from the Missouri River by the hydraulic method and distributing it as needed to grade over the entire area. *Second,* securing the material for making the fill from the bluffs on the opposite side of the railroad and about an average of three-quarters of a mile distant to the east. The Carmichael-Cryder Company, well-known engineers and contractors of St. Louis, were the successful bidders on the job, and we feel that the problems confronting them, and the novel manner with which they overcame the difficulties encountered, will prove of more than unusual interest to the readers of *The Excavating Engineer.*

First Plan Found Inexpedient

The first plan proposed was found to be inexpedient because the area to be filled was on an average of about three-quarters of a mile from the nearest point on the Missouri River where the material might be obtained. Of course, this made direct pumping impracticable on account of the exceedingly high friction head which would be encountered in pumping through such a long distance, the cost of the pipe line, the power requirements, the expense of maintenance, and the expense incidental to distributing the material over such a wide area. The alternative to this was to establish a dewatering and loading plant on the banks of the river, and haul the material by train about the same distance that would be required under the second plan, or an average of three-quarters of a mile.

General view of the site of the Wabash Railway's new Kansas City general yards, with the engine terminal in the central background.

Hydraulic Fill Found Impractical

Aside from the consideration of cost, the greatest difficulty in securing the material in this manner was the fact that it would have been necessary to secure the approval of the Government Engineers before taking the material from the river. When the amount of red tape that is usually necessary in securing the consent of any department of the Government for work of this kind was taken into consideration, it was decided at once that too long a time would be necessary to make this plan desirable, even if it were economical in its other aspects.

It was, therefore, decided that the most practical way to secure the material was from the bluffs on the opposite side of the railroad. This involved the crossing of a much-traveled highway running parallel to the railroad and a double track used by three railroads, on which there were about sixty carded trains during the ten-hour period between 7:00 o'clock in the morning and 6:00 o'clock in the evening. This made it necessary to adopt the plan which would encounter the minimum of interference from any source.

Crossing a Railroad and Highway

The three plans presented were: *First,* crossing at grade, which on account of the traffic both on the highway and railway seemed to present so much interference as to be undesirable because of an excessive loss of time during the operating period. *Second,* building a trestle crossing both highway and railway above grade, clearing the highway not less than 15 feet and the railway not less than 22 feet, in order to comply with the laws governing such crossings. Inasmuch as the area to be filled lay from twelve feet to eighteen feet below the grade of the tract to be crossed, it was seen at once that a trestle would be so expensive that it was only to be considered in case no other expedient could be devised. Therefore, the question resolved itself into finding some other method of crossing the highway and railroad with the material. This was somewhat complicated by the fact that the material was to be taken from the bank in a narrow strip and about 150 feet wide, paralleling the railroad for a distance of 2000 feet, and averaging about forty feet in depth. The material was what is known in geologic terms as loess, being apparently uniform in character throughout.

There were two ways in which this material might be handled over the highway and railway and on to the dirt trains for transportation and distribution over the area to be filled: *First,* by loading into small cars to be hauled over a movable tram-road and dumped into the dirt trains; or, *Second,* by carrying across on a belt conveyor. This last plan was the one finally adopted—a traveling conveyor consisting of a structural steel bridge 100 feet in length and inclined at an angle of about fifteen degrees from horizontal, spanning the highway and the double-track railroad. At the discharge end this conveyor was supported on a tower in such a manner as to allow considerable freedom of movement in all directions. The material was discharged into a hopper and chute, which fed it into cars. This conveyor cleared the base of the rail 22 feet or more, and the highway 15 feet or more, thus complying with

Showing the manner in which the conveyor spanned both the highway and railroad. Legal requirements of fifteen feet over highway and twenty-two feet over railroad met economically.

the legal requirements. Both the discharge and loading ends were carried on structures which were supported on double-flanged wheels, thus enabling the conveyor to be moved on a track parallel to the railroad as the material within reach was depleted.

The material was carried from the shovel to the loading end of this horizontal conveyor by a supplementary conveyor of equal length, which worked radially from this one through a maximum arc of 220 degrees. This inclined conveyor was fed at the loading end by an apron feeder working under a hopper into which the steam shovels discharged the material. This hopper was about ten feet square at the top, and was surmounted by a grizzly made of rails, which prevented lumps, rocks, stumps, or other material too large for the conveyor to handle, going through. Into this hopper the material was fed by a Bucyrus 50-B caterpillar shovel with a 1¾-yard dipper, supplemented by a Bucyrus 20-B shovel with a ¾-yard dipper. The combined capacity of these shovels was estimated at 200 cubic yards hourly. The belt conveyor was rubber covered, 36 inches in width, and traveled at a speed of approximately 300 feet per minute. Each conveyor was driven by a motor — the horizontal by a 20 horsepower, and the inclined by a 30 horsepower. The apron feeder was driven by a chain sprocket from the tail pulley of the inclined conveyor.

The first material was loaded on April 27, 1925, and the work proceeded at a uniform rate until February 15, 1926. A good deal of delay was encountered during the months of September and October on account of rain, but with that exception, and those interruptions to operation which may be termed normal, no serious interruptions occurred from start to finish. The largest amount of material delivered in one day was about 3600 cubic yards — car measure. It may be stated, however, that the material was of such a light and fluffy character that the loads which measured 16 cubic yards to the car made a little more than 11 cubic yards in the settled embankment, although the estimate of daily yardage was based on twelve cubic yards to the car.

The material was moved from the end of the belt conveyor in standard gauge equipment, using twelve-yard air dump cars, moving in trains of from nine to ten cars. Three locomotives were employed, two being used to haul the trains and one to operate a spreader, working double shift. With the exception of about 60,000 cubic yards team side borrow, all of the material was delivered by train haul with the apparatus described above.

We are indebted to W. P. Carmichael, president of the Carmichael-Cryder Company, for the information contained in this article.

According to the Secretary of Labor, Mr. Davis more than 11,000,000 of the people in the United States depend upon the construction industry for their living, and 22% of all the skilled labor of the country is engaged in the building branch alone.

1¾-yard shovel loading into hopper of the conveyor carrying excavated material across a much-traveled highway and a busy railroad. Note the train of twelve-yard cars on the other side of the railroad receiving the excavated material from the conveyor.

The Excavating Engineer

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F. O. WYSE, Manager-Editor
South Milwaukee, Wisconsin
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The Business Situation

A late spring and cold unseasonal weather during the first six months of the year had begun to create quite a little pessimism. The opening of the second six months, however, has left little basis for such views. Commodity prices are more stable, both trade and production have continued at a higher level than was expected by many. Practically every branch of business, and this includes the retail trade, has responded to more seasonal weather. The so-called key industries, namely, building, steel and automobile manufacturers, have utterly failed to justify any pessimistic predictions. Steel buying has been much more lively than in the immediate past and this activity has apparently encouraged everyone. In fact, as this is written, the business of the United States Steel Corporation continues at an unusually high rate for the month of July, namely, around 80 per cent of capacity. The steel industry, as a whole, produced over twenty-four million tons during the first half of the year and is expected to produce a like quantity during the last half. The automobile industry, while at a slightly lower level than during the preceding months, quite a normal, seasonal change, is leading the production of last year at this time. There is little pessimism apparent in the report that the General Motors Corporation is about to spend forty million dollars among its subsidiary companies as follows:

Chevrolet — Eight million dollars for a new plant.

Oakland-Pontiac — Five million dollars for new construction at Pontiac, Michigan.

Buick — Five million dollars for a body plant at Flint, Michigan.

Delco Light Co. — Twelve million dollars for a plant to build Frigidaire units at Dayton.

Hertz Drivurself Corporation — Ten million dollar investment.

The earnings, according to a statement to stockholders, for the first quarter of the year, were $38,733,942 or $7.50 a share.

Building contracts awarded show a gain over last year's figure, although apparently there is a good deal of regional variation.

The money situation is a very interesting one, for almost invariably before a business readjustment of any moment there appears a decided stiffening of the money market (although, of course, a stiffening in the market does not augur definitely any business readjustment, as it may be due to over-extension on the stock exchange) and at the present time there seems to be a plentiful supply of cheap money. While there is no prospect that there will be any further easing of the money situation in the immediate future, there seems to be plenty of funds available at reasonable rates to satisfy the needs of industry.

In fact, with the exception of the textile industries, business in general is doing very well. The high level of employment is still another factor. The continued high railway traffic and the volume of the checks drawn and cashed at banks, still others. The following table taken from a business bulletin issued by the National City Bank of New York, shows the daily bank debits by months in 1925 and 1926 and shows the extent to which the figures have been maintained and early year gains over last year.

January	$856,813,000	$943,231,000	10.1
February	844,154,000	912,714,000	8.1
March	816,108,000	867,854,000	6.3
April	792,000,000	866,000,000	9.3
May	816,000,000	857,034,000	5.0
June 1-23	823,000,000	877,902,000	6.6

Agricultural conditions are satisfactory. The probable yields for both winter and spring wheat together is placed in the vicinity of 770 million bushels as against 669 million bushels last year.

The prices of pork products, which have been unusually high, are expected to have some readjustment as the relationship between the corn production and the production of hogs is brought more nearly to normal. The outlook in the cattle industry is viewed with optimism.

Another bumper cotton crop is expected.

The Manhattan stock market during the first half of the year showed total trading in the amount of 224,928,600 shares, a daily average of 1,509,587 shares. This figure is a record.

General Motors reached a high record during the second week of July of 149¼, with a sale for that week of 386,000 shares on the Manhattan Stock Exchange. The activity of the exchange is shown by the following turnover of common stock:

U. S. Steel	600,700
Willys-Overland	473,300
Standard Oil, California	314,500

· FIELD NOTES ·

Saving the Flues

Flues are made of comparatively thin material, and, therefore, a blast of cold air through them causes a rapid contraction.

The fact that the boiler shell, which holds the flue sheets in place, does not contract at the same time, causes a stress in the tubes which eventually pull them loose at the flue sheet, usually at the firebox end.

Therefore the fire door should be opened only when it is necessary.

To check the fire use the draft door, and see that this draft door is practically air-tight. In fact, the whole ash pan from the grate down should be as nearly air-tight as it is possible to make it.

We have record of one good fireman who rigged up a system of levers so that instead of opening the fire door, he could immediately throw the smoke box doors open when it became necessary to check the fire, and thus short circuit the draft through the smoke box.

When leaving the boiler at night, close the draft door and the fire door whether or not it is intended to carry the fire over night, and save the flues.

Removing a Broken Stud

When a stud is broken off short, and it is not possible to use a pipe wrench on it, or to saw a slot in it for a screw driver, it may often be unscrewed with a hammer and cold chisel by catching the point of the chisel out close to the thread and tapping lightly with a hammer in the unscrewing direction.

If the stud is stuck in the thread, tapping it straight down with a hammer and punch may jar it loose so that it may be removed as described above. Sometimes a little kerosene will help, especially if there is time to let it soak in.

In obstinate cases erect an "old man" and drill a hole down through the center of the stud, drive in a tapered square punch, apply wrench to the projecting punch, and, very often, the stud will unscrew readily.

Patience and coaxing are valuable assets in stubborn cases.

Wash the Boiler Carefully

When cleaning a boiler, great care should be taken to remove all pieces of scale. Thoroughly flushing with a strong stream of water will remove all sediment and floating impurities.

One of the commonest causes of the blisters and sags found in boiler tubes and shells is unequal heating due to the presence of scale.

Steam Shovel Don'ts

Don't neglect to blow out the steam or water gauge connections, and also the pressure gauge connections as often as the character of the water demands. Be sure they are always free.

Don't neglect to regulate the feed pump or injector to suit the requirements of an even water level. A constant feed is best.

Don't forget to clean the boiler at intervals to suit the kind of water used. Draw the fire, allow the boiler to cool slowly, blow out the water, open the manholes and handholes, scrape out the sludge with a long-handled hoe, and wash out thoroughly with a strong stream of water from a hose.

Don't forget to see that the blower pipe is clear after cleaning boiler. Test it by drawing off some water through this pipe.

Don't forget to clean the flues at least once a week, and sometimes two or three times a week depending on the draft. A strong draft will deposit less ashes in the tubes than a weak one.

Cylinder Bores

The old method of boring engine or pump cylinders by a shallow cut with a finishing tool has never produced perfect cylinders under conditions of volume production; heating, clamping and imperfect tools have always been causes of trouble.

The automobile industry has developed the practice of grinding cylinders, which produces a practically perfect bore, but the old method of boring still prevails in many engine and air compressor shops.

It is, therefore, interesting to learn that the Chicago Pneumatic Tool Co. have adopted the ground bore for all portable compressors, with the idea of improving the volumetric and mechanical efficiency of their compressors.

Fairly good boring can be done by a competent workman, but where a perfectly true and smooth bore is desirable the grinding process is safer and better.

Castor Oil

As a preventative for foaming castor oil probably leads the way.

Laboratory tests show that water saturated with castor oil has a surface tension of about 10 per cent less than that of pure water.

A large number of experiments have been made, but so far no general theory is advanced.

However, for the prevention of foaming of the sort caused by mixtures of dissolved substances and finely divided solid matter castor oil stands pre-eminent.

DEVICES YOU OUGHT TO KNOW ABOUT

Bucyrus Company Announces a New Shovel and Dragline

The 41-B, a 1¼-yard shovel, has recently been announced by the Bucyrus Company of South Milwaukee, Wisconsin. This shovel has been built primarily for those jobs of excavation where

capacity greater than that afforded by a 1-yard dipper is needed.

The shovel, which has a two-part hoist, is quickly and easily convertible to a dragline. The shovel is designed so that the drum speed is the same for dragline or shovel work. Therefore, all

that is necessary to convert the shovel to a dragline is to add the drag drum, change the booms and cables, and add the fairhead. The drag drum is mounted well back on the shovel, giving the desirable long lead from the fairlead to the drum.

As a dragline the machine is offered with a 40-foot boom and a 1-yard bucket, or a 45-foot boom with a ¾-yard bucket.

The capacities offered by this machine, both as a shovel and a dragline, have proven very popular, especially for the larger excavation jobs and for work outside the cities.

Except for the larger capacities and working ranges, making correspondingly heavier working parts, the Bucyrus 41-B is a companion machine to the Bucyrus 31-B, the one-yard shovel recently announced by this company.

Details for the machine are box girder boom, outside dipper handles, two-part hoist working over a large diameter sheave, cast base and revolving frame, and caterpillars employing larger diameter roller and tumblers. It takes its place midway between the 31-B 1-yard shovel and the 50-B, a 1¾-yard shovel.

The Bucyrus Company now offers caterpillar-mounted revolving shovels in three classes: small revolving shovels; mine and quarry and general utility large revolving shovels; and stripping shovel, with dipper capacities ranging from ¾ of a yard to 8 yards. Bucyrus draglines range in size from ½ yard to 8 cubic yards.

Cylinders Mounted at Right Angles Give Perfect Balance to Air Compressors

Construction jobs, factories, ship yards, mills, foundries, railroad shops, municipal water works, quarries and mines, find excellent use for the Angle Compound Compressor, type WJ-3 manufactured by the *Sullivan Machinery Company, Chicago, Illinois.* It is said that this motor-driven machine, of capacities ranging from 400 to 800 cubic feet, has perfect balance and is free from vibration.

The distinctive feature of this Angle Compound design is that the high-pressure and low-pressure cylinders are mounted at right angles to each other, and both pistons are actuated from one crank so as to give perfect balance of reciprocating forces. The air is compressed first in the horizontal cylinder, and then travels through a three-pass, counter-current, water intercooler to the vertical cylinder where it is further compressed. Water inlet and outlet valves, and automatic lubrication, insure uninterrupted operation. The machine may be driven by a belt or direct connected to a Westinghouse motor.

New Curb and Gutter Ditcher

The *Barber-Greene Company, Aurora, Illinois,* have recently placed on the market a new curb and gutter ditcher. This machine, it is said, will cut a trench 32 inches wide and 3 feet 6 inches

The New Barber-Greene Curb and Gutter Ditcher Excavating for Curb and Gutter Forms

deep at the rate of 5 feet per minute. The specifications are the same as the Barber-Greene standard ditcher, except that it has two bucket lines mounted in parallel. One bucket line cuts 21½ inches and the other 10½ inches.

In addition to being an efficient machine for curb and gutter work, it is believed that the machine will prove worth while for uncovering old pipe lines of various descriptions.

New A-C Starter

A new starter announced by the *General Electric Company* bears the type designation CR-7055-A-1. It is a reversing primary resistor starter for squirrel cage induction motors.

Two three-pole line contactors are provided with this starter. These contactors are electrically and mechanically interlocked, and are mounted back-to-back on the panel. A magnetic time interlock provides a predetermined definite time of from one to three seconds between the closing of the line contactor and of the accelerating contactor.

Two-point starting is provided by a resistor designed to conform to Electric Power Club Classification No. 16. A temperature overload relay with an external resetting mechanism furnishes overload protection.

SHOTS FROM THE · FIRING LINE ·

Central States Notes

Herman C. Haugk is running a Bucyrus 20-B shovel owned by Babb & Smith for the Highway Improvement Company of South Bend, Indiana. There are two of these machines on the job. Mail will reach him at 224 South Lafayette Street, South Bend, Indiana.

Iowa and Missouri Notes

BY H. C. EMERY

Fred M. Crane Company of Omaha are awaiting disposition of the bonds before starting the contract recently awarded them in Missouri.

Phelps & Sons of Knoxville, Iowa, were recently awarded the contract for a big sewer in Providence, Rhode Island, which we understand entails about 300,000 yards of excavation. We are also informed that Mr. Robert Phelps will have immediate supervision of the work.

Briggs-Drew-Boyce Company of Omaha are getting away to a flying start on their drainage contract at Fry's Mill, Arkansas. They recently added a Bucyrus 30-B oil dragline to their equipment. Clarence Boyce and Phil Briggs are on the ground superintending the work.

Roberts Brothers of Chicago and Paterson-Shirley & Gunther of Omaha have the contract with the Union Pacific for ending the fill east of the Missouri River Bridge in Council Bluffs. There is about 75,000 yards in the job, and Roberts Brothers' Bucyrus 70-C is doing the loading at Summit, with Union Pacific flat cars and engines to do the hauling. D. W. Hickey is at the levers of the Bucyrus 70-C. Charlie McKosky is on the boom and John Lindholm is making the smoke. This is rather a hurry-up job as the widened fill will enable the Union Pacific to extend the tracks of their icing plant.

Wills-Mayo and Clark of Clinton, Iowa, were the successful bidders at a letting of a drainage project at Paragould, Arkansas, July 6th. These people were awarded Sections Nos. 2 and 3 with an approximate yardage of 1,077,000 yards. Section No. 1, entailing approximately 920,000 yards, was awarded to Geo. Clark of St. Louis, Missouri. The price for Section No. 1 is reported as being 8½ cents, with 9 cents for Sections Nos. 2 and 3.

The following were low bidders on a number of State Highway projects at Jefferson City, Missouri: Holt County, Route 1-F, Section 1, Geo. W. Condon Co., Omaha, Nebraska; De Kalb County, Route 36, Section 9, Metropolitan Paving Co., St. Joseph, Missouri; Sullivan County, Route 6, Sections 33B, 34A and 35B, Thayer Construction Co., Shelbyville, Missouri; Putman County, Route 4, Sections 51, 52, 54 and 55, E. P. Olson, St. Joseph, Missouri; Platte County, Project 96A and 96B, Richmond Construction Co., Excelsior Springs, Missouri; Benton County, Route 65, Section 68, Ross Construction Co., Des Moines, Iowa; Cooper County, Route 5, Sections 47 and 48, Graham Bros., Leeds Missouri; Camden County Route 15 Sections 69 and 70, Lahar Bros., Lee's Summitt, Missouri; Taney County, Route 76, Sections 5, 6 and 7, N. E. Stone & Co. & H. H. Ruddell, Jefferson City, Missouri; Dent County, Route 19, Sections 21A, 22A, 23A and 25A, A. A. Davis & Co., Kansas City, Missouri; Shannon County, Route 19, Sections 28, 29, 33, 37, 38 and 40, Chaney & Amyx, Licking, Missouri; Ripley County, Route 42, Sections 10 and 11, James C. Ellis, Rockport, Indiana.

Mr. E. Gentry writes that he is operating a Marion 37 electric at Fort Dodge, Iowa. Uncle Sam's mail will reach him addressed to 604 South 18th Street, Fort Dodge, Iowa.

SHOTS FROM THE FIRING LINE — Cont.

New England Notes

L. S. Martin writes that he is stripping a granite quarry with a Bucyrus 100-C for the Rock of Ages Granite Company, Barre, Vermont. Mr. Henry Harris is cranesman and Geo. McGraw, fireman. Mr. Martin can be reached by mail at Barre, Vermont.

New York and Vicinity

BY T. A. BURNS

Freeman & Kelso of Staten Island have been awarded the Echo Lake Development job by the North Jersey Water Commission. This indicates considerable success on the part of these gentlemen, and we are sure all of their friends wish them luck.

Corson Contracting Company have started work on their Brooklyn subway extension job. The steam shovel equipment has been furnished by the Marion Company.

Mr. L. Lyle is chief engineer for the Boxley Contracting Company, driving the tunnels at 194th Street and Bennett Avenue.

We have been informed by Mr. Connors of the English Construction Company of New York that they have procured a job near Providence, Rhode Island, comprising two hundred thousand yards of excavating.

Lewis Di Menna has been awarded the Boston Post Road work by the City of New York.

Lewis Passarelli, one of our friends of New Rochelle, came to town last week.

Hannan & McKee, a newly formed but active concern of Brooklyn, are considering adding to their steam shovel equipment which indicates progress.

The subway work is progressing rapidly throughout the city, and if this continues we may expect a completed program in 1928.

An additional four hundred million dollar water project is necessary for the City of New York, beginning about 1928.

Pacific Coast Notes

BY J. H. SACKETT

Contract awarded to John Phillips, 637 Santa Ray Avenue, Oakland, for $150,000 for constructing fill across Lake Almanor, Plumas County, for the Great Western Power Co., San Francisco, and Red River Lumber Co., work involving approximately 600,000 cubic yards fill.

Bond election will probably be held in September by the city of San Diego, San Diego County, to vote on issuing bonds in the amount of $2,000,000 for the construction of the Sutherland Dam, Vicente Dam and necessary pipe lines. F. A. Rhodes is city engineer of San Diego and A. P. Davis, Ray Building, Oakland, is consulting engineer. Type of dams not yet selected.

Plans and specifications being prepared by City Engineer F. A. Rhodes, City Hall, San Diego, for the construction of a new seawall at Mission Beach. Estimated cost $400,000.

Plans and surveys are being made by the Atchison, Topeka and Santa Fe Railway, Kerchoff Building, Los Angeles, for electrifying railroad between Los Angeles and Bakersfield. $800,000 is the estimated cost.

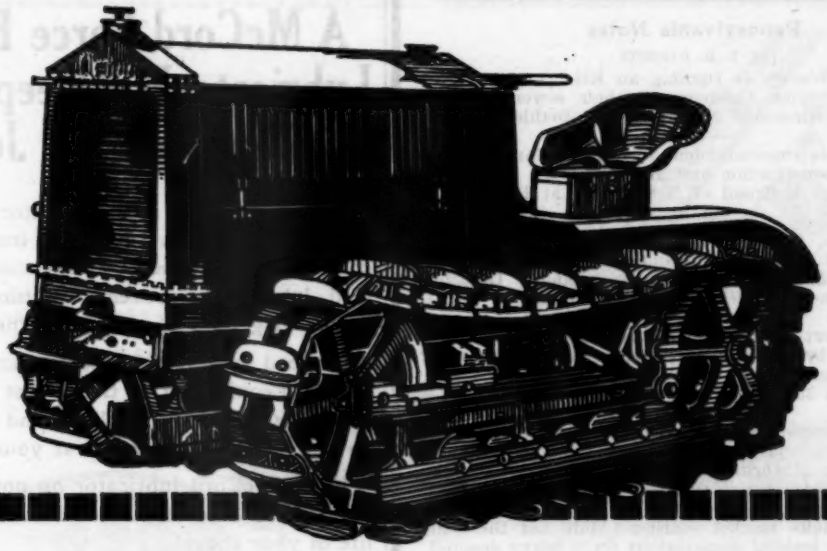
Plans are being made by City Engineer's Office, City Hall, San Francisco, bids to be called in about 90 days for the improvements of streets in Golden Gate Heights. Work involves 6,700 cubic yards 1-2-4 concrete; 910 cubic yards rubble walls; 654,000 pounds reinforcing steel; 200,000 cubic yards excavation; 3,600 square feet stone sidewalks; 22 brick manholes; 3 brick catch basins; 2 brick junction manholes; 700 feet 8-inch vitrified pipe sewer; 800 feet 12-inch vitrified pipe sewer; 120 feet 10-inch vitrified pipe culvert; 50 feet 12-inch "A" cast iron pipe; 1 storm water inlet; 60 concrete drainage sumps.

Bids have been received by United States Engineer's Office, 725 Central Building, Los Angeles, for dredging the main channel, Los Angeles Harbor, from its present depth of 30 feet to 35 feet at low water mark. Work involves approximately 1,700,000 cubic yards material to be removed. $700,000 is now available; balance to be secured next year. Major H. A. Finch is district engineer.

Plans are being prepared by County Surveyor Geo. Posey, Oakland, Alameda County, for the improving of the following projects: (1) Improvement of Smith Street, Alvarado, from main highway to Alameda Creek, grading, paving and draining ¾ of a mile; (2) Portions of Crow Canyon Road, widening, grading and drainage, 2½ miles; (3) East 14th Street, San Leandro to Ashland, grading, curbs, gutters, culverts, paving, 2 miles; (4) Bay Farm Island Road, trimming and surfacing, 1½ miles; (5) Decoto Road from State Highway to main road at Centerville, grading, paving and draining, 2¾ miles; (6) Mission San Jose Road from Irvington to Mission San Jose, grading, paving and draining, 2 miles; (7) Skyline boulevard extension to Berkeley, grading and draining, 2½ miles, cost $75,000.

Contract awarded to Kaiser Paving Co., American Bank Building, Oakland, at about $250,000 for the construction of earth fill dam, 80 feet high with crest of 360 feet (rolled type), to be known as the Philbrook Valley Dam, located on Philbrook Creek, northeast Plumas County, for the Pacific Gas & Electric Co., San Francisco, California.

R. Minard has for the past 3½ years been pulling the levers on M. S. Ross' Bucyrus 20-B steam shovel. As illustrated in the accompanying snapshot he is stretching the hemp in order to load the truck on the high bank.



Two Big Announcements

NOW EFFECTIVE!
$100.00
Price Reduction on Model K Cletrac

MODEL "K," the 3-plow Cletrac Crawler Tractor was added to the Cletrac line one year ago. The response from road contractors and state highway departments was immediate. This powerful tractor won instant favor everywhere — because it offered what was unquestionably the greatest improvement in tractor design and construction that had taken place in the past ten years. With steadily increasing production a price reduction of $100 has been made possible. Investigate this better tractor at once. Write for name of nearest distributor and descriptive literature.

NOW READY!
Model "A" Cletrac
30-45 H.P.

MODEL "A," the largest Cletrac Crawler Tractor — built to meet unusual power requirements and particularly for road construction and general industrial service — is now ready. Six-cylinder motor — 30 H. P. at draw-bar — 45 H. P. at power pulley. Simple, powerful, dependable — a duplicate in design of the successful Model "K," built in larger size and with corresponding increase of power and capacity. Write for full details.

Cletrac Crawler Tractors

The Cleveland Tractor Co.
Cleveland, Ohio

For convenience in making inquiry use postal inserted in this number.

SHOTS FROM THE FIRING LINE — Cont.

Pennsylvania Notes

BY T. H. BARRETT

Mr. Jack Warick is running an Erie for the Denberger Construction Company on their sewer job for the Central Railroad of New Jersey at Bethlehem, Pa.

Mr. Boyle is superintendent for James Hart of New York on the construction and grading of the new yard for the Central Railroad of New Jersey at Bethlehem, Pennsylvania.

Pat Brown, formerly operating the 320-B Bucyrus electric shovel at Hazelton, Pennsylvania, is now superintendent of the day shift. Bill Sheetz and J. H. Ellis are running the big machine on alternate shifts.

W. J. Gilbert of Hazelton has been awarded a stripping contract by the Cranberry Creek Coal Company of Hazelton, Pennsylvania. The work is near Harwood and involves about 350,000 yards, half of which is rock.

After a temporary shutdown of the strippings at Locust Gap, Pennsylvania, the Rhoads Contracting Company are again at work, they having been given an additional section adjacent to their old operations.

The anthracite market continues dull, but the coal companies are making preparations for a heavy demand in the fall.

The drafting and engineering departments of the Reading Coal and Iron Co. are busily engaged in completing the plans for the proposed new Alaska colliery breaker near Mt. Carmel, to replace the one destroyed by fire some time ago. The original plan for a breaker to be located so as to serve both Alaska and Reliance collieries has been abandoned.

At the present time officials of the Locust Gap and Reliance collieries are meeting with great difficulty in preparing the coal mined at the Alaska colliery in addition to their own productions. The lack of sufficient cars to convey the daily output to market has created an unusual situation at both Locust Gap and Reliance.

John Mullen, 117 Oakland Road, Upper Darby, Philadelphia, Pennsylvania, is running an Erie for the McLean Contracting Company. He is an experienced operator of both steam and Diesel shovels.

Southern States Notes

BY W. W. WHORLEY

W. J. Prince of Alberer, Mississippi, is operating a Marion 32 for J. J. Baxter at Yazoo City, Mississippi, on railroad work.

Winston Dredging Co. is moving one of their machines to a job near Grenada, Mississippi, on work which they have subbed from S. K. Jones of Memphis.

George Myers, who has been in charge of a highway job in Tennessee for J. W. Gwin, was a recent caller at this office. He was accomapnied by his brother, Henry Myers, who operates Mr. Gwin's Bucyrus 20-B shovel. They are now located on a new project at Everett, Glynn County, Georgia.

M. E. Kennedy wrote us recently from the land of oranges to say that he was running a Bucyrus 20-B near Fort Myers, Florida.

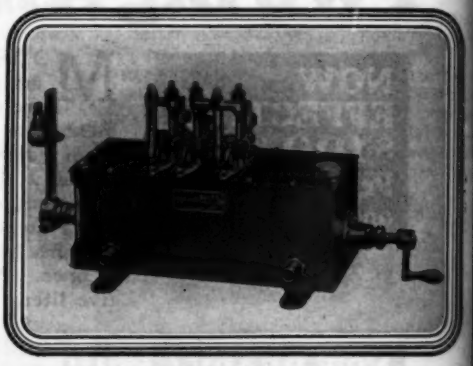
J. H. Bull advises that he has completed a gravel road between Fort Payne and Valley Head, Alabama.

A McCord Force Feed Lubricator Will Keep Your Shovel on the Job

A McCord force feed lubricator installed on your steam shovel now will insure more continuous operation. Dependable force feed lubrication prevents shutdowns and delays, it gives more hours on the job.

McCord force feed lubricators are used as standard equipment by the largest and best-known steam shovel builders and they will be installed on any shovel at your request.

Put a McCord lubricator on now and be assured of dependable lubrication for the life of your shovel.



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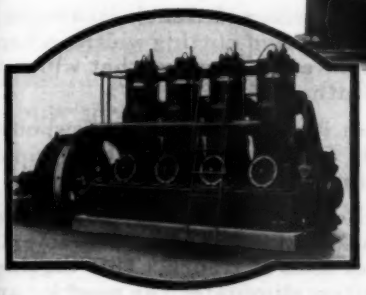
McCord Radiator & Mfg. Co.
Detroit, Michigan

McCord
force feed
Lubricators

For dragline excavators, power shovels, crawler and locomotive type cranes and dredges of all types, the F-M Diesel has proved the ideal power



For lower excavating costs

More than 30,000 horsepower of Fairbanks-Morse Diesel Engines are in excavating and dredging service today. The greater efficiency of this engine and its unusual savings are responsible for this rapid development.

With this engine standby losses are eliminated. Fuel is consumed only for productive work. The two-stroke-cycle airless injection design makes it an extremely simple engine to operate. Maintenance costs are low. Its greater simplicity naturally means greater dependability.

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Diesel Engines - Pumps - Motors

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SHOTS FROM THE FIRING LINE — Cont.

J. B. Turner advises that he is making the first fly on his Cullman County highway project. In order to speed up the shovel work, he has installed his second shovel, a new 31-B Bucyrus.

J. D. Morris, who has accumulated a nice coat of Florida tan, dropped in to see us recently. J. D. has been operating various machines in Florida, and was last with the Hollywood Land Development Co.

Jess H. Poag, who has been handling a dragline in the Mt. Pleasant district, reports that operations are being hindered by lack of water and that he is open for engagement. Anyone desiring a good dragline operator can reach him at Mt. Pleasant, Tennessee.

Another huge letting was held by the Tennessee State Highway Department in June. Following is a list of successful bidders: Davidson County, concrete pavement, Foster & Creighton, Nashville, Tennessee, $228,477; Davidson County, 67-A, rock asphalt, S. M. Billiter, Cincinnati, Ohio, $199,338; Campbell County, 77A, Shea Brothers, Knoxville, Tennessee, $88,342; Shelby County, 31-C, cement concrete, Hayes Construction Co., Jackson, Tennessee, $92,004; Shelby County, 36-D, grading and draining, W. H. Shons, Freeport, Illinois, $72,595; Monroe County, 323, grading and draining, Brown Contracting Co., Chattanooga, Tennessee, $29,529; Knoxville County, 332-A, Shea Brothers, Knoxville, Tennessee, $74,145.

St. Louis Items

BY A. B. KOENIG

Walter Denison was awarded contract by Rock Island Railroad for 41 miles of grading out of Amarillo, Texas. He can use 100 teams and fresno outfits on this job. Address him Amarillo, Texas, care of Engineer Rock Island Railroad.

Luther Oakes, president of Winston Bros. Co., visited their St. Louis office. That's another one of the good fellows the writer missed while on a fishing trip.

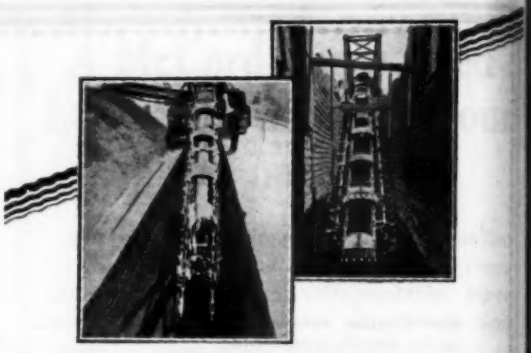
The W. E. Callahan Company of Chicago, Dallas and St. Louis were awarded contract for the construction of Sections B and C of the River Des Peres Sewer here. The Sections B and C will extend from Southwest Avenue to a point east of Machlind Avenue, a distance of approximately 10,000 feet.

Hoeffken Bros., Belleville, Illinois, started on another piece of road work near Jackson, Tennessee.

Winston Bros. Co. were awarded tracklaying and ballasting contract near Jefferson City, Missouri, by the Missouri Pacific Railroad.

John Marsch, Inc., started on their Mobile & Ohio job in Southern Illinois. This firm also has four shovel outfits at work on the Illinois Central Railroad cut-off in Illinois.

The J. J. McCaughey Co., Chicago, have a team and two dragline outfits at work in Michigan, digging out river for golf grounds and summer resort, also making lake in Cook County, Illinois. They are working a steam shovel and 40 teams on this and are putting the finishing touches to their park work in Chicago. Big Jack McCaughey was with us a couple of days looking over the sewer work to be let by the city of St. Louis. He returned home without bidding.



One Buckeye or Several Ordinary Trenchers?

Why buy *several* trench excavators, each with *limited* cutting widths, when you can have one Buckeye that will cut *many* widths?

Figure it out—from the viewpoint of profit. Consider not only the original cost—but operating expense as well.

The Rotary Auxiliary Cutter permits any Buckeye excavator to dig several widths or sizes of trench. This digging range often eliminates the need for an extra machine.

With all its great cutting range, a Buckeye costs no more than an ordinary excavator of limited digging ability. Consequently, in buying one Buckeye that will do the work of two ordinary trenchers, you save half your original investment. Other savings are interest, depreciation, repairs, etc., on the second machine.

Ask any Buckeye owner.

The Buckeye Traction Ditcher Company
Findlay, Ohio

Manufacturers of Trench Excavators (both Wheel and Chain-and-Bucket Types), Pipe Line Trench Excavators, Tile and Open Ditchers, Back-Fillers, Pipe Screening Machines, Curb Diggers and Clay Diggers.

THERE'S A BUCKEYE SALES AND SERVICE OFFICE NEAR YOU

BUILDERS OF TRENCH EXCAVATORS FOR OVER 30 YEARS

Sundown is no time to quit

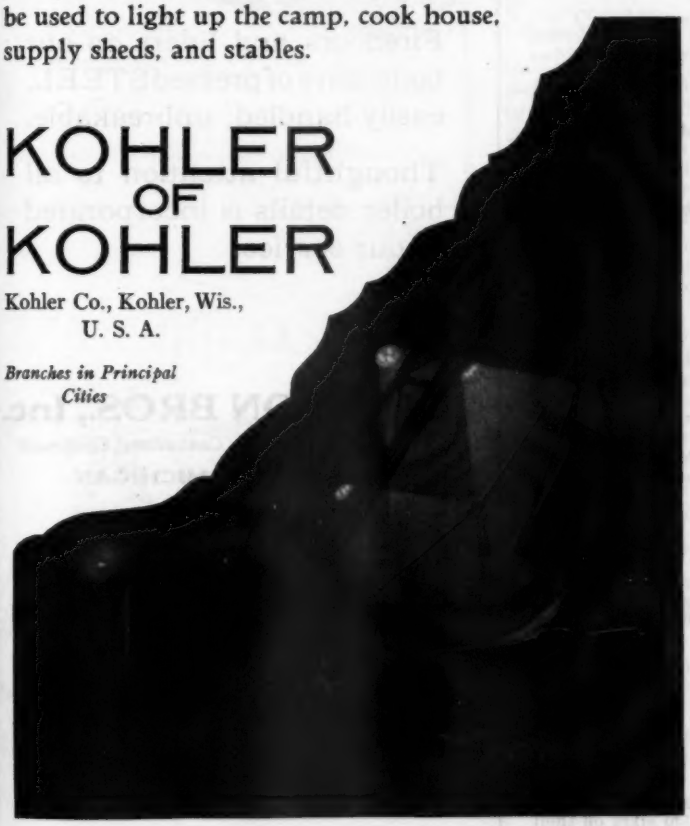
When unforeseen conditions hinder the progress of your jobs, when bad weather and breakdowns bring completion dates dangerously near, get yourself a KOHLER Automatic Electric Plant and light up for night work.

This sturdy, dependable electric plant can readily be mounted on your equipment, for it is compact.

It supplies enough current to floodlight extensive night operations, and to run portable electric power tools. It can be used to light up the camp, cook house, supply sheds, and stables.

KOHLER Automatic Electric Plants have been installed on many ditchers, draglines, pavers, shovels and other excavating and construction equipment. They repay their cost many times over by increasing the production per unit, which night work makes possible, by reducing overhead expenses, and by enabling their users to complete contracts on time.

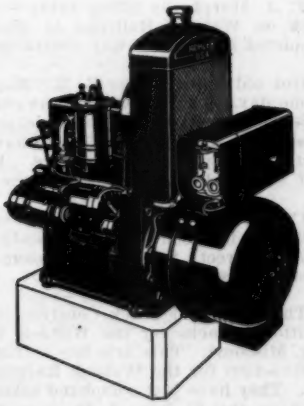
Send us your name and address for complete information and prices.



KOHLER
OF
KOHLER

Kohler Co., Kohler, Wis.,
U. S. A.

Branches in Principal Cities



Kohler Automatic Electric Plants

Model "D"—110 Volts—1500 Watts

4-cylinder, water-cooled engine.
Pressure lubrication to main bearings and rocker arms.
Crank shaft, cam shaft, connecting rods and rocker arms — drop forged, special steel, heat treated for strength and hardness.
High tension magneto ignition.
Generator — 4 pole, compound wound.
Measurements — Exclusive of starting battery, length 35 inches; width 16½ inches; height 35¾ inches.
Built also in 800-watt and 2000-watt capacities.

For convenience in making inquiry use postal inserted in this number.

SHOTS FROM THE FIRING LINE — Cont.

Keating Bros., Box 25, Clayton, Missouri, have a machine outfit and 20 teams idle.

W. A. Ross Construction Co., Wentzville, Missouri, have 18,000 yards of wheeler work at Grays Summit, Missouri, to let. Get in touch with Morris Wogan of this company at Wentzville, Missouri.

Chas. Gray, a first cousin of Hal Riley, was accidentally killed at 95th and Cottage Grove Avenue, Chicago, while dumping air brake cars on July 8th.

C. D. Herron, Glenwood, Missouri, reports 15 teams and a fresno outfit idle. He wants work for them.

Frank J. Specht of Bushnell, Illinois, was awarded contract for paving on Route 4, Section 12-W, Fulton County, Illinois.

The Hogan Construction Co. of Memphis, Tennessee, secured contract for paving District 16, Helena, Arkansas. Their bid was $154,236.00. Work will begin August 15th and completed within 120 working days.

The Mathes Coal and Construction Co., Davenport, Iowa, were awarded contract for paving four sections of Route, Jo Daviess County, Illinois.

P. J. Murphy is filling bridges and grading passing track on Wabash Railroad in Missouri. Murphy has completed all his highway contracts in Missouri.

Our old college chum R. M. "Mique" Quigley dropped in one day, when the writer was out fishing, on his way back to Fort Worth from Chicago. Surely sorry we missed you Mique, would like to have shown you a little Southern hospitality while here. Wire us before your next visit and we will postpone the fishing.

Contractors when in want of work or labor for their outfits get in touch with the Koenig Labor Agencies, 612 Walnut Street, St. Louis, Missouri, or 501 Delaware Street, Kansas City, Missouri.

The Industrial Track Construction Co. are putting in additional tracks for the Wabash Yards, North Kansas City, Missouri. This firm has started grading and track construction for the Wabash Railroad at Adrian, Michigan. They have just completed taking up 40 miles of old track on the El Reno & Western Railroad at Guthrie, Oklahoma. Also have about 15 track and ballasting gangs at work on the Wabash Railroad in Michigan, Ohio, Indiana, Illinois and Missouri. They are one of the busiest firms in this part of the country.

Twin City District News

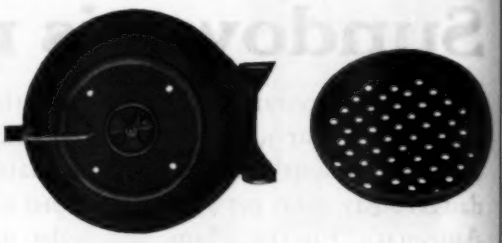
BY J. C. YETTER

Graham Brothers, Frazee, Minnesota, were recently awarded a grading contract in Walsh County, North Dakota.

Chas. F. Johnson, Forest Lake, Minnesota, is getting along very nicely with his grading work in Pine County, Minnesota.

Work on the new hotel in St. Paul is progressing very rapidly. The George J. Grant Construction Co. have the contract.

The M. J. Nolan Co. have completed five miles of paving on Highway No. 1, and have a good start on their eleven miles of paving on No. 5.



Boiler Details

Opening and closing a boiler firedoor, dozens of times per day, is not easy work.

Firedoors and liners on our boilers are of pressed STEEL, easily handled; unbreakable.

Thoughtful attention to all boiler details is incorporated in our service.

JOHNSTON BROS., Inc.

Specializing in Boilers for Contractors' Equipment

FERRYSBURG, MICHIGAN

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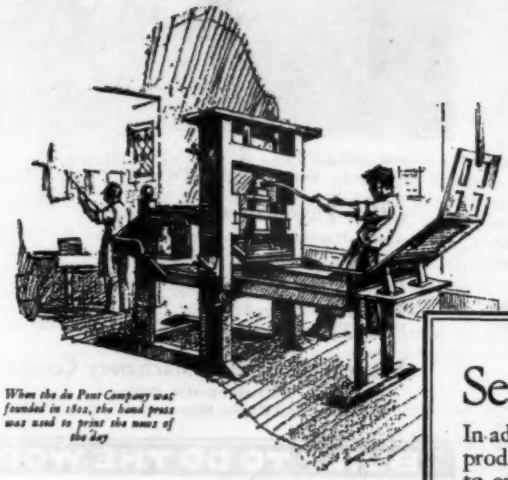
MAKERS OF POWDERS SINCE 1802



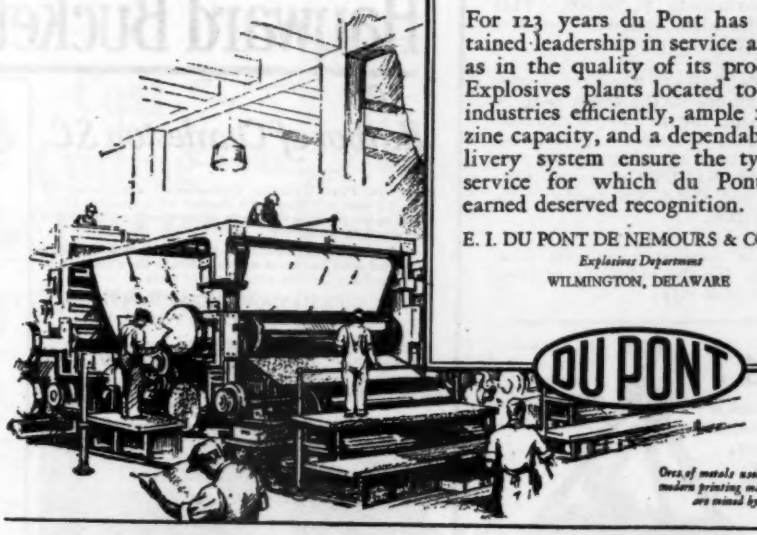
When the du Pont Company was founded in 1802, the hand press was used to print the news of the day

Service—

In addition to manufacturing a good product, provision should be made to ensure the product being easily available in quantities and at such times as required by users.

For 123 years du Pont has maintained leadership in service as well as in the quality of its products. Explosives plants located to serve industries efficiently, ample magazine capacity, and a dependable delivery system ensure the type of service for which du Pont has earned deserved recognition.

E. I. DU PONT DE NEMOURS & CO., Inc.
Explosives Department
WILMINGTON, DELAWARE



Ores of metals used in the manufacture of modern printing machinery and accessories are mined by explosive power

123 YEARS OF LEADERSHIP IN THE SERVICE OF INDUSTRY

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SHOTS FROM THE FIRING LINE — Cont.

The South Dakota State Highway Commission will receive bids on about one million yards of excavation at Pierre on July 20th.

Canada

Toronto and Vicinity

BY C. F. ENGLAND

Work was just recently started on a new sewage disposal plant for the township of East York, with the Goldie Construction Co., Limited, of Toronto, Ontario, as general contractor.

P. Lyall & Sons Construction Co., Limited, were the successful bidders for construction work for the Toronto Terminals Company at the new Union Station, Toronto. This work is in connection with the new viaduct, and contract price was in the neighborhood of $2,000,000.

The Ontario Government, Department of Northern Development, recently awarded contract to Construction & Engineering, Limited, Toonto, Ontario, for some twenty-two miles of road work between North Bay and Latchford, Ontario.

The Randolph MacDonald Company have started their contract at the Windermere Cut-off for the Ontario Department of Public Highways.

Vancouver and Vicinity

BY J. C. MOON

S. S. Magoffin & Company have secured the contract for completing the Harbor Boards Terminal Railway on the North Shore at a figure of $125,000 and will commence work at once.

Dredging Contractors, Limited, Vancouver, have secured the contract for the erection of the new Georgia Hotel at a figure of approximately $1,500,000. This building will be twelve stories high, and will comprise 310 rooms with five stores on the ground floor.

The new Canadian Pacific Railway Company's pier is approaching completion, and one of the sheds is to be ready to receive freight about the middle of August. The Sydney E. Junkins Company are the contractors for this pier, which is 1140 feet long of concrete pile construction, and will cost about $6,000,000 on completion. Growth of the Transpacific and Coast Steamship traffic have necessitated its construction.

The Cotton Company have secured a contract from the Canadian Pacific Railway for the extension of their yard tracks in the east end of the city.

Results!

It's the WILLIAMS combination of *speed* and *power* that makes this bucket a bigger producer.

Write for some records that WILLIAMS Buckets have made on work like yours.

G. H. Williams Company
603 Haybarger Lane, Erie, Pa.
Branch Offices:
New York Pittsburgh Chicago

WILLIAMS
FAST-DIGGING BUCKETS

Built so well that it is guaranteed against breakage.

TWIN CITY ENGINES

Northwest Crane in work on a Western Water project. Equipped with a TWIN CITY ENGINE.

Other Twin City users include:

Austin Machinery Corp., Baldwin Locomotive Works, Buckeye Traction Ditcher Co., Bucyrus Co., Inland Engineering Co., The Parsons Co., Pennsylvania Pump & Compressor Co., Star Drilling Machine Co., Washington Iron Works, Willamette Iron & Steel Works, etc. Specify Twin City Engines on your equipment. Sizes 35 to 140 H. P. Write for literature.

Minneapolis Steel & Machinery Company
Minneapolis, Minn.
Heavy Duty Engine Manufacturers Since 1903

"BUILT TO DO THE WORK"

Hayward Buckets

at Harbor of Charleston S.C.

Here the Port Utilities Commission supplemented their 18-year-old Hayward Bucket with another Hayward, again proving that only a Hayward can duplicate Hayward performance.

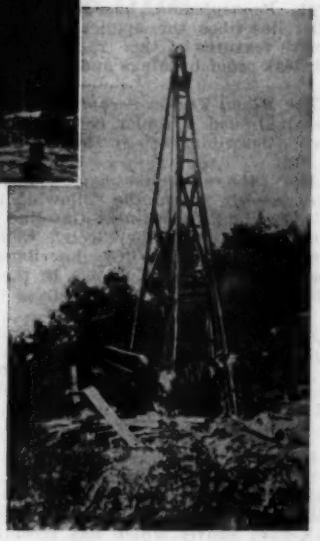
Let Hayward Engineers show you photographs, supply data and send bulletins which indicate the economy of Hayward Buckets on your class of work.

THE HAYWARD COMPANY
52-54 Church Street, New York, N. Y.

Builders of Clam Shell, Orange Peel, Drag Line, and Electric Motor Buckets; Dredging, Excavating, Coal Handling Machinery; Automatic Take-Up Reels; Counterweight Drums. 3397-Y

CYCLONE DRILLS

—on the S. I. and K. R. R. job.



THERE was a great deal of heavy rock work on the Southern Illinois and Kentucky Railroad job. Twenty-three blast hole drills of the well driller type were used by the several contractors. Twenty-one of these twenty-three were Cyclone Drills. The machines shown belong to A. Guthrie & Co., Inc.

Our book *"Big Blast Hole Drills"* (120 pages) is of interest to anyone interested in heavy rock excavation. Ask for a copy.

The Sanderson-Cyclone Drill Co.
Orrville, Ohio
Eastern and Export Office: 30 Church St., New York

Cost Cutting "SCHRAMM" Compressors

"SCHRAMM" No. 120 Operating Drill on Sewer Job

Three Reasons Why:
Does the work of ten men working by hand.
Fuel consumption regulated by slow down governor.
Easy to move from one job to another.

SCHRAMM, Inc.
MANUFACTURERS
Home Office and Factory: West Chester, Pa.

54 Dey Street, New York
549 W. Washington Street, Chicago
331 Fourth Avenue, Pittsburgh
709 Arch Street, Philadelphia

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TRADE NOTES

A 4-page descriptive leaflet on the new shovel-type transformers designed and manufactured by the *Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania,* has recently been issued. This leaflet describes the application, construction and distinctive features of this transformer, which is designed with leak-proof bushings and tank.

The Miami Trailer-Scraper Company, Troy, Ohio, has recently issued a folder entitled "Have You Earth to Move?" describing briefly their trailer-scraper.

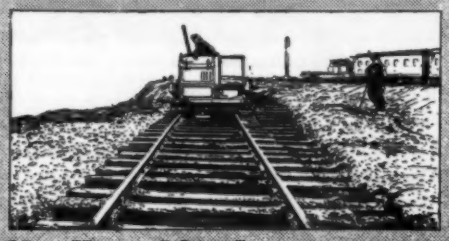
The Climax Engineering Company, Clinton, Iowa, have recently issued the following bulletins: Bulletin "E" describing the Climax Gasoline Power Units; Bulletin "F" describing the Electric Generators Direct Connected; and Bulletin "G" describing their Centrifugal Pumps Direct Driven. Copies of these bulletins may be had upon writing the above address.

The Hayward Company, 50 Church Street, New York City, has recently issued a bulletin No. 627 covering the use of Hayward buckets and other Hayward equipment in the mining or digging and distribution of sand and gravel. Copies may be had upon writing the above manufacturer.

The Bucyrus Company, South Milwaukee, Wisconsin, have just issued two new bulletins, Bulletin C-312 describing and illustrating the new 31-B 1-yard shovel and Bulletin C-411 illustrating and describing the new 41-B, a 1¼-yard shovel which has recently been announced. Copies of these bulletins may be had upon writing to the above address.

THE NORDBERG PATENTED
TRACK SHIFTER
It will shift and raise track on waste Dumps-open Pit Mines Quarries-Construction Work Behind Steam Shovels

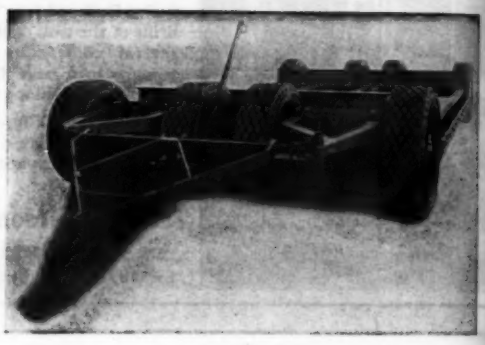
Here is a machine that will eliminate the use of track jacks and bars, cut track crew to less than half, and do four times the work.
Write for Bulletin GR-8.



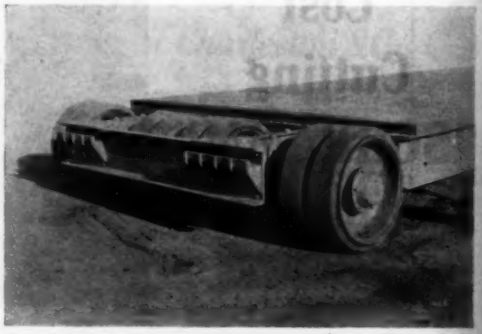
Nordberg Mfg. Co. MILWAUKEE WIS. U.S.A.

MOVE to the next job without delay —without injury to your machines — use a

TRAILER



(Built to carry Steam Shovels)



(Rear end construction for end loading)

BUCYRUS COMPANY
SPECIALTY DEPARTMENT
SOUTH MILWAUKEE, WIS., U. S. A.

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Roebling

Blue Center Steel Wire Rope

Roebling Wire Rope can always be depended upon to lift the heaviest loads and to give the longest, trouble-proof service. It is the choice of the man who wants the best on the market and freedom from worry.

Write for Catalog.

John A. Roebling's Sons Company
Trenton, New Jersey

Real Economy

TAYLOR-MESABA Steam Shovel Chain has proven time and time again that its long life and durability, resulting in great yardage records being established, make it the most economical over a period of time.

If maximum production is your aim, equip your shovels with TAYLOR-MESABA Chain, and eliminate chance. For over 50 years it has rendered consistent service to hundreds of users.

TAYLOR MESABA
STEAM SHOVEL CHAIN

CONSTANTLY WINNING AND HOLDING GOOD WILL

S. G. TAYLOR CHAIN CO.

502 Marquette Building (*Established 1873*) **CHICAGO, ILLINOIS**

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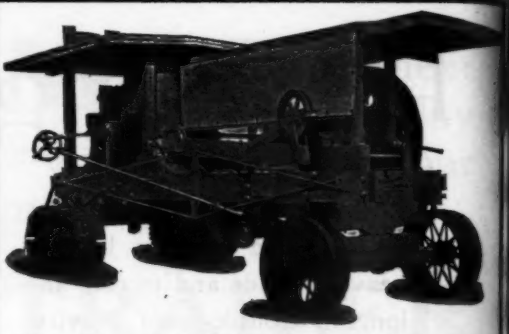
REVIEW OF BOOKS and CATALOGS

We shall be glad to review, in this column, such books and catalogs as are sent to us.

DEVELOPING MACHINERY MARKETS ABROAD—5½ x 9 inches, 18 pages. This bulletin has been prepared by the *Industrial Machinery Division, Department of Commerce, Bureau of Foreign and Domestic Commerce, Washington, D. C.*, to indicate concisely the methods that have been successfully used by a large number of machinery manufacturers in developing their business in foreign countries. A copy of this booklet may be obtained by machinery manufacturers or exporters upon application to the above address.

A PRELIMINARY EXPERIMENT ON THE SUPPORTING STRENGTH OF CULVERT PIPES IN ACTUAL EMBANKMENT—6 x 9 inches, 32 pages and cover. An illustrated report on highway research investigation conducted at Ames, Iowa, by the Iowa Engineering Experiment Station in co-operation with the United States Bureau of Public Works. Published by the *Engineering Experiment Station, Iowa State College, Ames, Iowa.*

THE INSPECTION OF STRUCTURES AT OWNER'S EXPENSE—6 x 9 inches, 12 pages. Prepared by Edward C. Kerth, consulting engineer, Evansville, Indiana, and read before the twelfth annual building official's conference, at Columbus, Ohio. Copies may be obtained upon applying to the *Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois.*



New Type "CLIPPER" Blast Hole Drill in Crawler or Round Wheel

The First Crawler Blast Hole Drill ever produced! Has proven an unqualified success.

When equipped with 40 H. P. gasoline engine for soft and excessively bad moving it gives a unit that shoves right through.

The "CLIPPER" is known among users as THE DRILL THAT DRILLS. One of the reasons it predominates.

The Loomis Machine Company
(Established 1843)
K Street, Tiffin, Ohio

Miami's Haul Your Earth! Costs Less Than Dragging It!

Ninety per cent of your loose earth moving cost by tractor consists of drivers wages, gasoline, oil and general upkeep, or $10.00 to $12.00 per day.

You MUST MOVE a given yardage to repay this expense. YOUR PROFITS come only from the EXCESS yardage per day.

THE MIAMI one-man POWER SCRAPER delivers twice the yardage of the common drag type scraper, because the pan is elevated in front after loading and hauls this load on roller bearing wheels to the dump, instead of dragging it.

Your driver delivers a full load where you want it, delivers more loads per day. This extra yardage at the dump means a considerable larger operating profit per day. Hundreds of contractors are getting it, ARE YOU?

Write today for complete information on the Miami Scraper.

The Miami Trailer-Scraper Co.
603 South Clay Street Troy, Ohio

ONE PRINCIPLE FOR TWENTY YEARS

PITTSBURGH

In speaking of Balanced Door Dump Cars, one of the nation's great operators said, "I doubt if a better principle for designing dump cars will ever be discovered." Careful buyers realize the years of underlying development work which have produced different equipments for their consideration. When one of these is based on a better principle than the rest, it is probably more economical to buy.

CLARK CAR COMPANY
BALANCED DOOR DUMP CARS
PITTSBURGH, PA.

San Francisco Rialto Bldg. | Chicago Peoples Gas Bldg. | New York 52 Vanderbilt Ave. | Boston 683 Atlantic Ave.

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RESENTING AN IMPROVED EXPLOSIVE

Chemists in the Hercules laboratories are always trying to improve explosives. Not simply to produce something new and different, but something more useful and efficient. Occasionally this constant effort is rewarded and a valuable ddition is made to the list of commercial explosives.

ercules Special No. 1 and Special No. 2 were really important con- ibutions of recent years to the blasting industries. Where these xplosives are suitable, a 15% reduction of blasting costs by their use not uncommon. They are most widely adapted to quarry and pen-pit work.

he economy of Special No. 1 and Special No. 2 naturally appealed underground miners, also. They are used successfully in some nderground mines, but their fumes make them unsuitable for others.

he newly developed Hercules Special No. 3 has all the advantages of pecial No. 1 and No. 2 with better fumes, and makes possible the eduction of costs underground to the same extent that Specials No. 1 nd No. 2 lower costs in the open.

ercules Special No. 3 represents another step ahead in commercial xplosives. It meets a long-existing need. It is not a cure-all, but here it is adapted to the work, it will save money. Particulars about is new explosive will be gladly furnished.

HERCULES POWDER COMPANY

(INCORPORATED)

949 KING STREET, WILMINGTON, DELAWARE

Sales Offices:

ALLENTOWN, PA.
BIRMINGHAM
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SALT LAKE CITY
SAN FRANCISCO
WILKES-BARRE, PA.
WILMINGTON

In writing to Hercules Powder Co., Inc. please use post card bound in the center of this number.

This picture taken two years ago in Africa shows a method of earth moving which is in use in some parts of the world even today.

An eight-yard dragline mounted on caterpillars. This machine, although weighing over 500 tons, is capable of propelling itself, even over soft ground.